PROC. ENTOMOL. SOC. WASH.
89(4), 1987, pp. 682–686

APICAL SENSILLA ON THE ADULT AND LARVAL LABIAL AND MAXILLARY PALPI OF *ODONTOTAENIUS DISJUNCTUS* (ILLIGER) (COLEOPTERA: PASSALIDAE)

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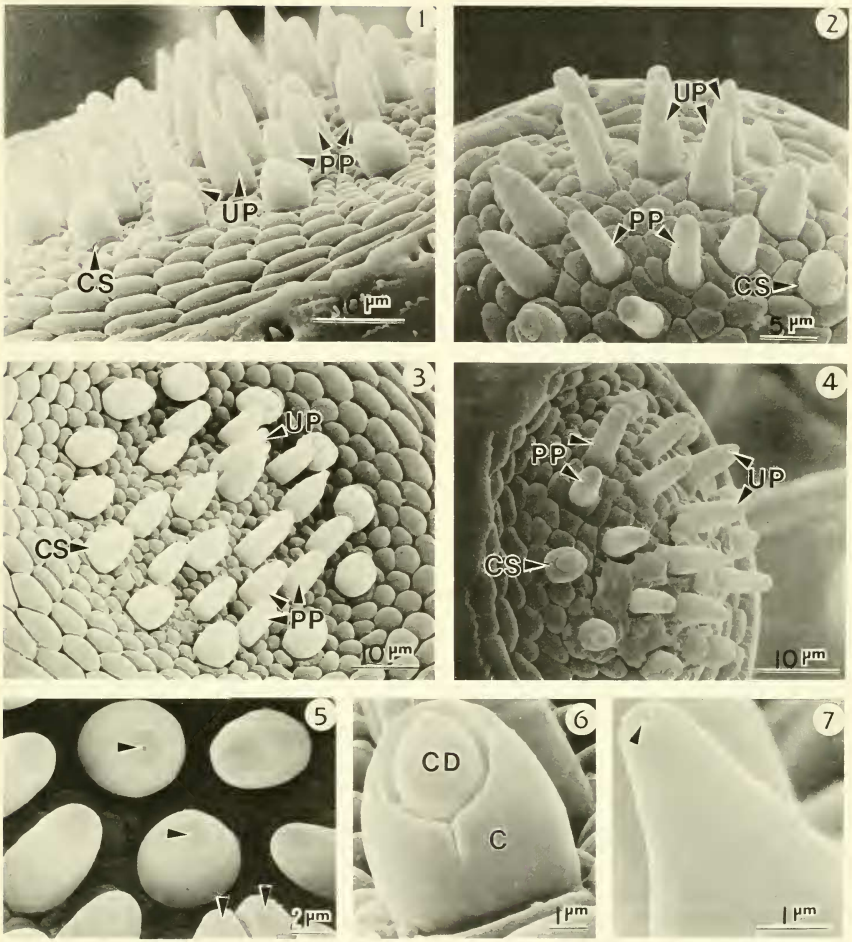
Abstract.—Three distinct types of sensory receptors are situated in the sensory field on the apex of the adult and larval labial and maxillary palpi of *Odontotaenius disjunctus* (Illiger) (Coleoptera: Passalidae). The coronal pegs are located on the periphery of the apical sensory field, and each one consists of a central disc and notched collar. There are short and long uniporous sensilla, which have a large apical pore, and short and long multi-porous sensilla. There are no differences between adults and larvae in the types and distribution of these sensilla, except in the total number of sensilla and the number of chemoreceptors on the apex of the palpi.

Members of the family Passalidae exhibit a primitive type of social behavior and are large and easy to rear. These beetles have generated a considerable amount of research interest (Pearse et al., 1936; Gray, 1946; Krause and Ryan, 1953; Reyes-Castillo and Jarman, 1980, 1983; Schuster and Schuster, 1985; Schuster, 1983). Both the larvae and adults are able to stridulate (Reyes-Castillo and Jarman, 1980, 1983), and this aspect and others of their behavior have received considerable attention (Gray, 1946; Mullen and Hunter, 1973; Schuster and Schuster, 1985). Although it is well documented that cuticular sensilla play an important role in the behavioral repertoire of insects (Kaissling, 1977; Seabrook, 1978; Zacharuk, 1980; Chapman, 1982; Bell and Cardé, 1984), only one study deals with the thin walled and porous sensilla on the antennal flagellum of a passalid beetle (Slifer and Sekhon, 1964). At the present time there are no papers that compare the sensilla on the larval and adult palpi of *O. disjunctus* or other beetle species. It is known that these sensilla on other beetles are involved in gustatory and olfactory responses (Bassler, 1958; Klinger, 1966; Kellogg, 1970; White et al., 1974). This paper compares the morphology, number, and distribution of sensilla on the apex of the labial and maxillary palpi of larval and adult *Odontotaenius disjunctus* (Illiger).

MATERIALS AND METHODS

Adults and larvae were obtained from rotting logs. Labial and maxillary palpi were cut from the larval specimens and placed in fixative. The adults had to be dissected to enable sexing of the specimens before the palpi were fixed. The fixative contained 5% glutaraldehyde in 0.2 M Na-cacodylate buffer, pH 7.2, and the palpi were fixed for 24 h at 4°C. The palpi were washed in the same buffer and then post-fixed in 3% OsO_4 for 24 h at 4°C. The specimens were dehydrated, critical-point dried and attached to stubs which were then coated with gold/palladium. The material was examined with a Hitachi HHS-2R scanning electron microscope at 20 kV.

In order to identify the presence of porous



Figs. 1–7. Palpal sensilla of *Odontotaenius disjunctus*. 1, Adult maxillary palpus. 2, Larval maxillary palpus. 3, Adult labial palpus. 4, Larval labial palpus. 5, Apex of short uniporous sensilla (arrows) and short multiporous sensilla. 6, Coronal sensillum. 7, Apex of a long uniporus sensillum (arrow = pore). C = collar; CD = central disc; CS = coronal sensillum; PP = multi-porous sensillum; UP = uniporous sensillum.

cuticular areas, live adults and larvae were stained with the reduced silver nitrate technique of Schafer and Sanchez (1976) and the crystal violet method of Slifer (1960). The labial and maxillary palpi of 10 adults and larvae were cleared and mounted in Hoyer's medium. Measurements were obtained by using a light microscope with an ocular micrometer and are given as an average plus the range. The data on the num-

Table 1. Comparison of the total number of sensilla on the apex of the maxillary and labial palpi.

	Mean ± SD
Adult maxillary palpus	32.30 ± 0.82 a
Adult labial palpus	28.20 ± 0.79 b
Larval maxillary palpus	22.30 ± 0.82 c
Larval labial palpus	18.70 ± 0.67 d

Means not followed by the same letter are significantly different ($P < 0.01$) as determined by ANOVA followed by Student-Newman-Keuls Test (n = 10).

Table 2. Comparison of the total number of chemoreceptors on the apex of the maxillary and labial palpi.

	Mean ± SD
Adult maxillary palpus	21.90 ± 0.74 a
Adult labial palpus	17.10 ± 0.57 b
Larval maxillary palpus	14.20 ± 0.63 c
Larval labial palpus	11.00 ± 0.67 d

Means not followed by the same letter are significantly different ($P < 0.01$) as determined by ANOVA followed by Student-Newman-Keuls Test (n = 10).

ber of apical sensilla were subjected to analysis of variance followed by Student-Newman-Keuls Test ($P < 0.01$).

Results and Discussion

The apical sensilla on the labial and maxillary palpi of *O. disjunctus* can be divided into three distinct types, coronal sensilla, uniporous sensilla and multi-porous sensilla. The first type, coronal sensilla, are situated on the periphery of the sensory field on the apex of the labial and maxillary palpi (Figs. 1–4, 6), and encircle the other sensilla. This sensillum is 5.5 μm wide at the base and 7.1 μm (6.6–7.4) long. There are two distinct morphological features of this sensillum; the first is the central disc (Fig. 6) and the second is the collar which surrounds the disc. The disc is 2.2 μm (1.9–2.4) wide and 3.1 μm (2.8–3.2) long, and the basal portion is rounded whereas the apex is nipple-like (Fig. 6). The collar of the coronal sensilla is higher in the inner surface than the outer surface where it has a well-defined notch (Figs. 1, 3, 6). The collar portion differs greatly from the collar found on coronal sensilla of other beetles which have a collar of uniform length and no frontal notch (Doane and Klinger, 1978; Whitehead, 1981; Hallberg, 1982). From ultrastructural information (Whitehead, 1981; Hallberg, 1982) and their non-porosity as indicated by the lack of staining with reduced silver nitrate and crystal violet, this type of sensillum is considered to be a mechanoreceptor. The coronal sensillum is not found on all beetle larvae and adults, for example *Lyctus brunneus* (Stephens) (Iwata and Nishimoto, 1981) and *Sitophilus oryzae* (L.) (Speirs et al., 1986), but when it is situated on the palpi, this receptor is found on the periphery of the apex (Doane and Klinger, 1978; Hallberg, 1982).

Within the circle of coronal sensilla there are two other types of sensilla, uniporous and multi-porous pegs (Figs. 1, 2, 4). The uniporous pegs can be further subdivided into short 9.5 μm (9.3–10.2) and long 19.7 μm (19.4–20.7) pegs that are 5.3 μm (5.0–5.5) wide at the base. These sensilla have a tapered apex with a large, single pore (Figs. 1, 3, 5, 7). Uniporous sensilla are found on the palpal apex of scolytids. Their ultrastructure indicates that this type of sensillum is a mechano- and contact chemo-receptor (Whitehead, 1981; Hallberg, 1982). The multi-porous pegs may be divided into short 8.9 μm (8.7–9.4) and long 19.3 μm (18.8–19.6) and are 4.9 μm (4.7–5.3) wide at the base. This type of sensillum has a blunt, rounded apex as compared to the uniporous pegs (Figs. 1, 5). The ultrastructural information on this sensillum from other beetles indicates that it may be an olfactory receptor (Whitehead, 1981; Hallberg, 1982). Both types of the above-mentioned sensilla stain with crystal violet and reduced silver nitrate. This demonstrates their porosity and is an indication of a possible chemoreceptor. The sensilla on the apex of the palpi of other beetles are known to respond to a wide variety of olfactory and gustatory stimuli

(Mitchell and Schoonhoven, 1974; White et al., 1974; Doane and Klinger, 1978).

There are no differences between adult females and males in the morphology, number and distribution of the apical sensilla. There is no difference in the morphology and distribution of the sensilla between adults and larvae, but there is a distinct difference in their number (Tables 1, 2). The adult maxillary palpus has the greatest total number of apical sensilla and the larval labial palpus the least (Table 1). This is also observed for the total number of chemoreceptors (Table 2). The order for the total number of sensilla and chemo-sensilla would be the following: adult maxillary palpus > adult labial palpus > larval maxillary palpus > larval labial palpus. This distinct dichotomy may be due to the more complex behaviors of the adults, such as mating, host finding, aggression and brood care (Mullen and Hunter, 1973; Schuster and Schuster, 1985).

Acknowledgments

I thank S. B. Ramaswamy, G. Tyson, D. Adamski, and an anonymous reviewer for reviewing the manuscript and B. Perrigin for typing it. This paper is assigned No. 6630 of the Mississippi Agriculture and Forestry Experiment Station.

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